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Expert Learners:

Cognitive Information Processing Theory

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Summary of Cognitive Information Processing

Cognitive information processing (CIP) theory is often referred to as simply "information processing." Information processing is not really the name of a single theory; it is a generic name applied to various theoretical perspectives dealing with the *sequence* and *execution* of cognitive events. Schunk (1996) offers the following helpful summary/definition:

> Information processing theories focus on how people:
>
> 1. **attend** to environmental events,
> 2. **encode** information to be learned and **relate** it to knowledge in memory,
> 3. **store** new knowledge in memory, and
> 4. **retrieve** it as needed.

Thus, learners are viewed as **active seekers and processors of information.**

CIP's Memory Model

At the heart of **CIP** theory is its proposed **memory system**. This theory uses the computer metaphor with its inputs and outputs. CIP theory focuses on what happens *in between input and output*, i.e., on *information processing*. Get familiar with Figure 1 and think deeply about the flow of information it represents.

Pay

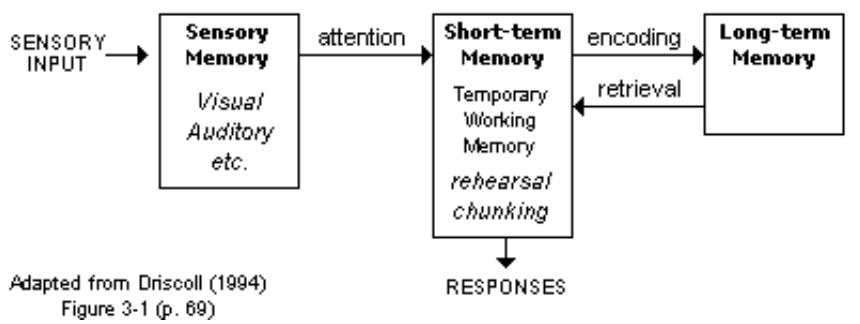

Figure 1: How Information Flows According to CIP Theory.

Text version of Figure 1

attention not only to the basic components or memory stages:

- sensory memory;
- short-term memory (STM); and
- long-term memory (LTM),

but also to the processes that keep information "alive" or help transfer it from one memory stage to the next:

- attention;
- rehearsal;
- chunking;
- encoding; and
- retrieval.

CIP Definitions and Explanations

The Components of Memory

Figure 1 above displays the three basic components of **CIP**'s proposed memory system—sensory memory, short-term memory (STM), and long-term memory (LTM)—along with the processes assumed to be responsible for transferring information from one stage to the next.

Brief descriptions of the three stages of memory follow:

- **Sensory memory** holds information associated with the senses (e.g., vision, hearing) just long enough for the

information to be processed further (mere seconds).

- **STM** functions as a temporary working memory, whereby further processing is carried out to make information ready for long-term storage or for a response. Working memory holds information for a limited amount of time and holds a limited amount of information.
- **LTM** represents our permanent storehouse of information, capable of retaining an unlimited amount and variety of information.

The Flow of Information During Learning

Information is transformed or processed as it passes from one stage of memory to the next. However, processing doesn't really occur in the unidirectional, linear way implied by the diagram. For example, the mental representation one forms of a sentence s/he reads is determined both by the information itself (data-driven, bottom-up processing) and by one's prior knowledge (conceptually driven, top-down processing).

Additionally, in some way, an executive monitor keeps track of the information flow and makes decisions about processing priorities. This may occur in a conscious, strategic fashion or in an unconscious, automatic way.

Keep these two things in mind:

- The computer provided a concrete metaphor for human information processing and, thus, a language for describing it.
- For learning and instruction to be meaningful and relevant, it must build upon the learner's prior knowledge and help the learner to make connections between what they already know and what they are about to learn.

Selective Attention

Selective attention refers to the learner's ability to select and process certain information while simultaneously ignoring other information. Several factors influence attention:

- The meaning that the task or information holds for the individual
- Similarity between competing tasks or sources of information
- Task complexity or difficulty (influenced also by prior knowledge)
- Ability to control attention (which differs with age, hyperactivity, intelligence, and learning disabilities)

More About Short-Term Memory

Working memory is also known as STM or short-term memory. At this stage, concepts from LTM (long-term memory) will be activated for use in making sense of the incoming information.

STM has limited capacity: Seven bits of information (7 ± 2) have been shown to constitute the memory span for a great variety of materials. However, each bit of information can vary tremendously in size. Hence, working memory capacity may be increased through creating larger bits, the process known as **chunking**. Accordingly, learning tasks should be organized so that they can be easily chunked by the learner.

Unrehearsed information will be lost from working memory in about 15 to 30 seconds. To prevent the loss and ensure that information is transferred to LTM, two processes are necessary: **rehearsal** and **encoding**.

Rehearsal

Maintenance rehearsal refers to the repetition of information in order to maintain it in STM for some designated period of time. Maintenance rehearsal is not enough for complex or meaningful information to reach

LTM. This can be accomplished through **elaborative rehearsal**, otherwise known as **encoding**.

Encoding

Encoding refers to the process of relating incoming information to concepts and ideas already in memory in such a way that the new material is more memorable. Various encoding schemes include:

- Organization, e.g.:
  - grouping information into categories
  - outlines
  - hierarchies
  - concept trees
- Mnemonics
- Imagery

Nearly any method of elaborative encoding is better for learning than mere repetition of information. Which approach is best depends upon the learners and the material to be learned. Learners may be taught to develop and use their own strategies effectively, such as inventing their own mnemonics or utilizing self-questioning.

Retrieval of Information from Long-Term Memory

The process of retrieval from LTM involves bringing to mind previously learned information, to either (a) understand some new input or (b) make a response. Making a response may involve either recall or recognition.

Recall

In **free recall** situations, learners must retrieve previously stored information with no cues or hints to help them remember. **Cued recall** tasks are those in which a hint or cue is provided to help learners remember the desired information.

Recognition

Recognition involves a set of pregenerated stimuli (e.g., multiple-choice questions) presented to learners for a decision or judgment.

Retrieval Cues

The process of retrieval can be greatly influenced by the cues available to learners at test time. For example, the **encoding specificity** principle states that whatever cues are used by a learner to facilitate encoding will also serve as the best retrieval cues at test time.

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